PHYSICAL MATHEMATICS SEMINAR

A frog, a scallop, and a grain of sand: Coastal sediment transport and the breakdown of the scallop theorem

DAVID GONZALEZ-RODRIGUEZ
Massachusetts Institute of Technology

ABSTRACT:

This talk will have two parts. In the first part, I will discuss the prediction of sediment transport across the beach profile due to nearshore waves and currents. A typical beach profile experiences an annual cycle, in which sand moves offshore during the winter and returns to the emerged beach in the summer. Net cross-shore sediment transport, responsible for this annual cycle, is the small difference between two large quantities, the off- and onshore transport rates. In order to predict beach profile evolution, it is therefore necessary to accurately model all involved sediment transport mechanisms. Here, I will discuss the effect of wave nonlinearity on sediment transport and present an analytic, predictive sediment transport model based on a conceptualization of the turbulent boundary layer hydrodynamics.

In the second part, I will discuss the breakdown of the scallop theorem with particle inertia, of relevance to the swimming mechanics of small organisms as they grow in size. Due to the kinematic reversibility of Stokes flow, a body executing a reciprocal motion cannot propel itself in a viscous fluid in the limit of negligible inertia; this result is known as Purcell's scallop theorem. Previous studies characterized the breakdown of the scallop theorem with fluid inertia. I will present a general theoretical framework and specific examples to show that, even in the absence of fluid inertia, certain dense bodies undergoing reciprocal motion are able to swim.

TUESDAY, NOVEMBER 4, 2008
2:30 PM
Building 2, Room 105

Refreshments at 3:30 PM in Building 2, Room 349
(Applied Math Common Room)

Massachusetts Institute of Technology
Department of Mathematics
Cambridge, MA 02139